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Similar but not quite the same: Differential unique associations of trait fear and trait anxiety with inhibitory control

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Abstract

Given the dearth of research regarding the relations of trait fear and trait anxiety to cognitive control processes, we sought to investigate how trait fear and trait anxiety are uniquely related to inhibitory control, which is a crucial component of the regulatory processes that inhibit inappropriate responses that interfere with goal achievement. Given that inhibitory control tasks are often plagued by task-impurity issues, we employed a latent variable approach based on multiple measures of inhibitory control. We found that trait fear and trait anxiety are related but separable constructs that, when their shared variance was controlled for, predicted inhibitory control positively and negatively, respectively. Also, the unique negative relation between trait anxiety and inhibitory control was evident only for females. Our findings underscore distinct contributions of trait fear and trait anxiety to inhibitory control and the consideration of affective traits as multidimensional (e.g., valence and motivation) constructs to better understand the relation between negative affectivity and cognitive processes.

Keywords

Fear, Anxiety, Traits, Negative affectivity, Inhibitory control

1. Introduction

Although extensive research has shed light on the cognitive correlates of negative affectivity (i.e., dispositional tendency to experience and express more frequent, intense, or enduring negative emotions), the associations between discrete negative affectivity and cognitive processes are still poorly understood (Shackman et al., 2016). Two relevant negative emotions of interest are fear and anxiety, as they are highly prevalent emotions that affect everyday behaviors. At healthy levels, fear and anxiety, as closely related emotions, facilitate adaptive responses to threats in order to preserve safety and well-being. At maladaptive levels, however, they are implicated in health problems and psychiatric disorders (Sylvers, Lilienfeld & LaPrairie, 2011). Although prior studies have predominantly treated fear and anxiety as analogous constructs (for a similar argument, see Sylvers et al., 2011), some empirical evidence suggests the contrary, thus supporting the distinction between fear and anxiety. Given these starkly different arguments, we sought to examine whether trait-level fear and anxiety would be similarly or differentially related to inhibitory control, a crucial component of cognitive and emotional regulation, which refers to an ability to inhibit goal-irrelevant interferences (distracting information) in order to achieve goals. Considering that inhibitory control has been shown to influence several key aspects of life, such as mental health (e.g., addiction or depression), physical health (e.g., overeating, substance abuse), and marital harmony (Diamond, 2013), understanding the relation of trait-level fear and anxiety to inhibitory control is vital.

Although both fear and anxiety are characterized by apprehensive anticipation of impending danger, one of the key distinctions between them is the specificity of the threat. With fear, there is an identifiable threat located in the environment that requires the recruitment of more controlled, top-down cognitive processes to manage the threat (Öhman, 2008). With anxiety, however, the nature of the threat is more ambiguous, which in turn impedes the efficiency to actively engage strategies and behaviors to deal with the threat (Öhman, 2008). Evidence from past studies supports this distinction between fear and anxiety. At the neuroanatomical level, although both fear and anxiety are subserved by the extended amygdala complex, the central nucleus of the amygdala is more strongly involved in fear, whereas the bed nucleus of the stria terminalis is more closely associated with anxiety (Walker, Toufexis & Davis, 2003). Additionally, behavioral genetics studies suggest that fear-related disorders (e.g., animal and situational phobias) and anxiety-related disorders (e.g., generalized anxiety disorder, posttraumatic stress disorder) are separable and associated with distinct genetic factors (Hettema, Prescott, Myers, Neale & Kendler, 2005). Further, while increased physiological responses (e.g., heart rate acceleration) accompany both fear-related and anxiety-related stimuli, anxiety-related disorders are also associated with elevated resting heart rate and skin conductance levels (Orr & Roth, 2000). Together, there is converging evidence that fear and anxiety are related, but dissociable, processes.

Given these distinctions between fear and anxiety, an important question is whether fear and anxiety would uniquely influence inhibitory control. From a theoretical standpoint, the revised reinforcement sensitivity theory proposes that different anatomical systems underlie fear and anxiety in terms of approach/avoid motivation (Gray & McNaughton, 2000). Specifically, the fight-flight-freeze system (FFFS), which is activated by threatening stimuli, mediates fear and is associated with avoidance behaviors. The behavioral approach system (BAS), which is activated by appetitive stimuli, mediates anticipatory pleasure and is associated with approach behaviors. Lastly, the behavioral inhibition system (BIS)—which is activated by goal conflicts, particularly between approach (BAS) and avoidance (FFFS)—mediates anxiety, especially in circumstances in which the threatening stimuli cannot be avoided and must be faced. Notably, in line with our proposed fear-anxiety distinction, the threat is more explicit and definite in the FFFS than in the BIS (i.e., actual versus potential danger). In view of this, motivational differences between fear and anxiety likely engender dissimilar outcomes in inhibitory control. Specifically, fear (as driven by the FFFS) may require the recruitment of more controlled, top-down cognitive processes to avoid the explicit threat (Öhman, 2008). On the other hand, the nature of the threat for anxiety (as driven by the BIS) is more ambiguous, and therefore anxiety may impede the ability to actively engage strategies and behaviors to deal with the threat (Öhman, 2008).

In a similar vein, Harmon-Jones, Gable and Price (2013) maintain that emotions that are high and low in motivational intensity—which refers to the strength of the urge to move toward or away from a stimulus—narrow and broaden the scope of attention, respectively. Specifically, fear likely signifies higher motivational intensity, owing to the strong desire to recoil from a specific negative stimulus, while anxiety reflects lower motivational intensity (Zhou & Siu, 2015) due to the ambiguity of the threat. Therefore, the apparent threat specificity and high motivational approach that are characteristic of fear could engender more selective attentional processes that implicate the suppression of distracting information, i.e., more proficient inhibitory control. Conversely, anxiety, owing to its lower motivational intensity and threat ambiguity, would likely be concomitant with lower inhibitory control. This is further supported by the attentional control theory (Eysenck, Derakshan, Santos & Calvo, 2007), which posits that anxiety engenders greater distractibility by increasing the influence of the stimulus-driven (bottom-up) attentional system and impairing the goal-directed (top-down) attentional system. Hence, the threat specificity and motivational intensity components of fear and anxiety would engender different outcomes in inhibitory control: Fear likely enhances inhibitory control, while anxiety hampers it.

Consistent with the notion above, experimental findings substantiate the divergent effects of fear and anxiety on inhibitory control. For instance, higher trait anxiety was associated with poorer performance on various measures that require the inhibition of irrelevant distractors (e.g., flanker task, attention network task, irrelevant-singleton paradigm) and prepotent responses (e.g., antisaccade and the Stroop tasks), even in the absence of threat-related stimuli (Bishop, 2009; Derakshan, Smyth & Eysenck, 2009; Fox, 1993; Moser, Becker & Moran, 2012; Pacheco-Unguetti, Acosta, Callejas & Lupiáñez, 2010; cf. Derakshan et al., 2009; Eysenck & Byrne, 1992). In contrast, fear has been shown to facilitate the top-down inhibition of distractor interference. Fear-induced participants exhibited better inhibitory control (as assessed by the flanker and Attention Network Tasks) than control participants, thereby indicating that fear is better able to suppress irrelevant information (Finucane, 2011; Finucane & Power, 2010). Given the malleable nature of inhibitory control in response to experiential inputs (Diamond, 2013), the aforementioned studies suggest that individual differences in experiences of fear and anxiety may manifest different relations with inhibitory control.

Despite the general consistency of findings in the literature, it is still premature to draw definitive conclusions due to the notable drawback of using a single task to assess inhibitory control (e.g., Bishop, 2009; Finucane, 2011). This is quite problematic, because inhibitory control measures typically assess more than just inhibitory control abilities, as evidenced by the low—and often statistically nonsignificant—correlations between various measures of inhibitory control (Friedman & Miyake, 2004). For instance, the color-word Stroop and the arrow flanker tasks tap not only inhibitory control but also task-specific abilities to recognize and discriminate colors and arrows, respectively. Crucially, task-specific idiosyncrasies may not only give rise to spurious positive findings but also potentially mask the genuine relations between inhibitory control and fear/anxiety, which could result in low correlations or even null findings (e.g., Eysenck & Byrne, 1992). Therefore, more rigorous methodological and statistical approaches are needed to circumvent the task-impurity problem.

To address this issue, we sought to assess the associations of trait fear and trait anxiety with inhibitory control by using a latent-variable approach based on multiple measures of inhibitory control, while controlling for common covariates (e.g., gender, age, socioeconomic status). Departing from previous studies that have relied on single-task measures (e.g., Bishop, 2009; Finucane, 2011), this latent variable approach allowed us to obtain a purer estimation of inhibitory control by accounting for measurement errors, thereby addressing the task-impurity problem.

Further, although the reviewed empirical evidence suggests that fear and anxiety are, respectively, positively (Finucane, 2011; Finucane & Power, 2010) and negatively (Fox, 1993; Moser et al., 2012; Pacheco-Unguetti et al., 2010) associated with inhibitory control, two major issues remain unresolved. First, since most previous findings were established at the state level as derived from mood-induction procedures—which more strongly activate the motivational aspects of affective experiences—it is not clear whether trait-level fear and anxiety would yield comparable findings. Corroborating this notion, prior work has shown that state anxiety and trait anxiety are dissimilarly related to certain aspects (i.e., alerting and orienting) of inhibitory control tasks (i.e., Attention Network Task; Pacheco-Unguetti et al., 2010). Second, given the multidimensional nature of affective traits (e.g., positive/negative valence, approach/avoid motivation), there may be trait-specific components (e.g., negative valence) that are not necessarily associated with inhibitory control (Gustavson et al., 2019).

Therefore, using a latent variable approach that allows unbiased estimation of parameters, we examined whether trait fear and trait anxiety would be uniquely related to inhibitory control when the shared variance between trait fear and trait anxiety was controlled for. Specifically, drawing on the evidence reviewed above, we hypothesized that higher trait fear would be uniquely related with more enhanced inhibitory control, while higher trait anxiety would be uniquely associated with impaired inhibitory control. In addition, given that females are more anxiety-prone and susceptible to anxiety-related disorders than males (Bernstein, Zvolensky, Stewart, Nancy Comeau & Leen-Feldner, 2006; Chambless & Mason, 1986; Lake, Eaves, Maes, Heath & Martin, 2000; Lewinsohn, Gotlib, Lewinsohn, Seeley & Allen, 1998; Zvolensky, McNeil, Porter & Stewart, 2001), we inquired whether gender would moderate the unique relation of anxiety with inhibitory control. Notably, we conjectured that the specific effects of anxiety on inhibitory control may be more pronounced for females than for males.

2. Method

2.1. Participants

One hundred and seventy-five undergraduates (M_{age} = 21.59 years, *SD* = 1.83; 66.3% female) from a local university in Singapore participated in the study for course credit or a monetary reward (S$30). As the data used for this experiment were part of a larger study, only relevant variables are reported[1]. Our sample size was guided by several considerations. First, the sample size of *N* = 175 is consistent with recommendations that a minimum sample size of 150 is appropriate for structural equation models (SEM) with seven or fewer constructs (Hair, Black, Babin & Anderson, 2009; Tabachnick & Fidell, 2001). Further, our sample size is comparable with past studies that have relied on multiple measures to assess inhibitory control (e.g., *N* = 130 to 171; Miyake et al., 2000; Unsworth, Fukuda, Awh & Vogel, 2014). Lastly, a more recent simulation study by Wolf, Harrington, Clark and Miller (2013) suggests that a minimum sample size of approximately 160 cases is required for the model with three latent factors and eight indicators when all factor loadings are set to 0.50. Given that our present SEM model has three latent factors and 10 indicators in total, a sample size smaller than 160 would be sufficient.

3. Materials

3.1. Fear and anxiety

To investigate individual differences in trait fear and trait anxiety in nonclinical populations, we opted for measures that tap general affective and personality traits. To this end, we employed the Positive and Negative Affect Schedule (PANAS) and the State-Trait Anxiety Inventory (STAI-T), which are widely used measures of trait affectivity (e.g., De Young et al., 2013; Eysenck & Byrne, 1992; Lerner & Keltner, 2001; Moser et al., 2012; Pacheco-Unguetti et al., 2010; Ready et al., 2011). Participants reported the extent (1 = *never*, 5 = *always*) to which they generally experience fear (i.e., *afraid, scared, nervous, jittery*) and anxiety (i.e., *distressed*) on the PANAS (Watson, Clark & Tellegen, 1988). The four items selected to index the latent fear factor constitute part of the fear subscale in the expanded version of the PANAS (PANAS-X; Watson & Clark, 1992), which showed positive correlations between self- and aggregated ratings from well-acquainted peers (*r* = 0.40) and with other construct-similar scales (e.g., the Tension-Anxiety subscale of the Profile of Mood States; $r = 0.85$; Watson & Clark, 1999), thereby indicating convergent validity.

Anxiety was assessed by the 20-item State-Trait Anxiety Inventory-Trait Version (STAI-T; Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1983; 1 = *almost never*, 4 = *almost always*), which demonstrated convergent validity, as evidenced by positive correlations with other anxiety scales (Stanley, Beck & Zebb, 1996; Watson & Clark, 1984). To reduce the number of items from the STAI-T, we used factorial algorithms to create two parcels that are 10-item mean scores of the 20-item scale. Parceling, which is appropriate for unidimensional scales such as the STAI-T, has been shown to have better psychometric properties (i.e., higher reliability and communality) and model-fit advantages (Little, Cunningham, Shahar & Widaman, 2002). Here, all items in the STAI-T were assigned to the two parcels to achieve roughly equal factor loadings.

3.2. Inhibitory control

Three inhibitory control tasks (Eriksen & Eriksen, 1974) assessed the resistance to distractor interference. In the modified Eriksen flanker task, participants saw a row of five letters and had to identify, as quickly and accurately as possible, the central target letter (i.e., *G* or *H*), which could be congruent (e.g., *HHHHH*) or incongruent (e.g., *GGHGG*) with the surrounding four letters. For every trial, a central fixation point (350 ms) was first presented, followed by the target stimulus, which remained on the screen for 2000 ms or until a response was made. A blank screen was then shown (250 ms) before the next trial began. To increase task difficulty, the central target letter was sometimes displaced from its central position (vigilance trials; e.g., *GG HGG*). Participants had to press the spacebar instead of identifying the central target letter. Eighty-five congruent, 85 incongruent, and 30 vigilance trials were randomly presented. As vigilance trials were not related to our study's hypotheses, we excluded those from analysis.

The other two inhibitory control tasks were methodologically similar, except for the stimuli employed. In the modified arrow flanker task, participants had to discern the direction of the central arrow (i.e., left or right), which could be similar to (e.g., <<<<<) or dissimilar from (e.g., <<><<) the surrounding four arrows. In the modified color flanker task, participants had to classify the color of the central box (i.e., green or red), which could be the same color as the other four colored boxes or a different color. The dependent variable in each task was reverse-coded bin scores, which comprised both accuracy and latency. Based on Hughes, Linck, Bowles, Koeth, and Bunting (2014) binning procedure, we excluded the following: (a) incorrect trials, (b) trials with RTs below 200 ms, and (c) trials with RTs that departed from each participant's mean by more than 3 *SD*. Subsequently, the mean RT of congruent trials was subtracted from every incongruent trial RT for each participant. Next, all participants' difference scores were rank-ordered into deciles and assigned bin values of 1 through 10 to signify the fastest and slowest 10% of the group, respectively; inaccurate incongruent trials were assigned bin values of 20. Last, for each participant, a single bin score was obtained by dividing the sum of the bin values from the accurate and inaccurate trials by the total number of incongruent trials; bin scores were reverse-coded by multiplying by −1 so that higher values denote better performance. Bin scores afford better reliability, validity, and sensitivity in the detection of larger effect sizes than pure latency or accuracy scores (Hughes et al., 2014).

3.3. Procedure

The study was approved by the University's Institutional Review Board (IRB-17-081-A082(817)), and informed consent was obtained from all participants before the study began. The study comprised three sessions, with 1-week intervals between each session. In Session 1, participants completed a battery of questionnaires that included the PANAS, STAI-T, and demographics (e.g., gender, age, socioeconomic status). In Session 2, the modified Eriksen flanker task was administered along with other tasks. For Session 3, participants completed the modified arrow and color flanker tasks, interleaved with other measures.

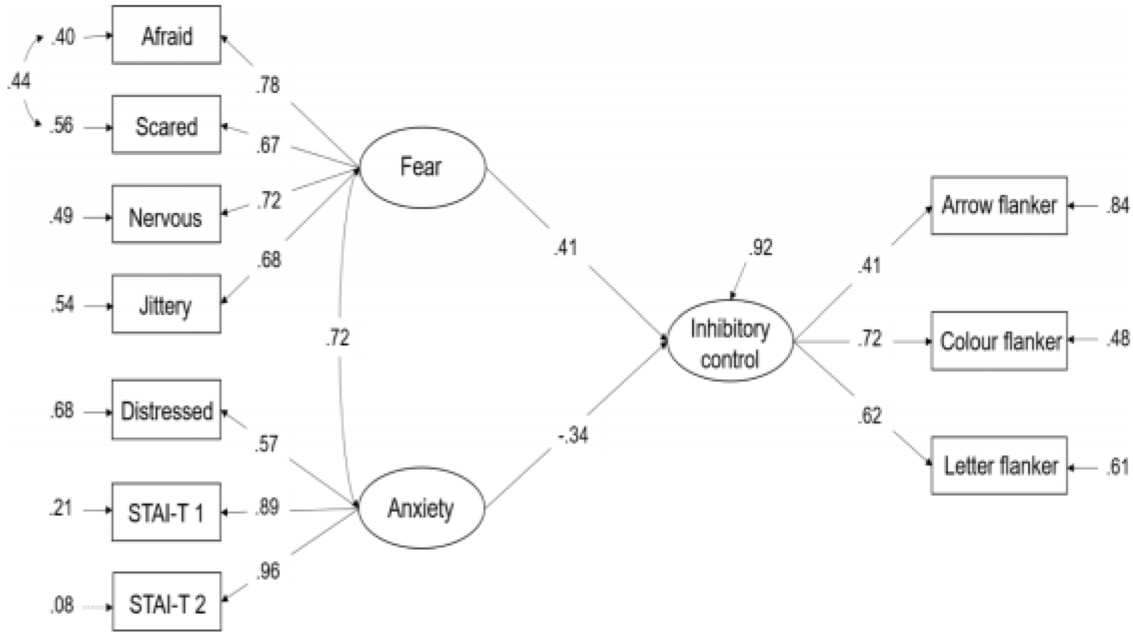
4. Results

All analyses were conducted with M*plus* 7.4 (Muthén & Muthén, 2015) using the full information maximum likelihood procedure with robust standard errors. All reported estimates for our main findings were standardized to allow for comparisons between constructs with different measurement scales. Descriptive statistics and zero-order correlations are shown in Tables 1 and 2.

We first assessed the measurement model, using confirmatory factor analysis, for the latent factors of fear (i.e., *afraid, scared, nervous, jittery* from the PANAS as indicators) and anxiety (i.e., *distressed* from the PANAS and two parcels from the STAI-T as indicators), which demonstrated a reasonable model fit, $\chi^2(13) = 23.76$, $p = .033$, RMSEA = 0.07, SRMR = 0.05, CFI = 0.98; all indicators significantly loaded on their respective latent factors (ps < 0.001), and the inter-factor correlation between fear and anxiety was 0.66 ($p < .001$). Further, following Crawford and Henry (2004), we correlated semantically similar items based on Zevon and Tellegen's (1982) mood content categories (i.e., *scared* and *afraid; nervous* and *jittery*). After correlating the error variance for *scared* and *afraid* and dropping the nonsignificant error covariance for *nervous* and *jittery*, the model had an excellent fit, $\chi^2(12) = 9.81$, $p = .632$, RMSEA = 0.00, SRMR = 0.02, CFI = 1.00. We also compared this two-factor model with alternative models. Specifically, the one-factor (i.e., all seven indicators loading onto one factor; $\chi^2(13) = 58.44$, $p < .001$, RMSEA = 0.14, SRMR = 0.08, CFI = 0.91) and independent (i.e., constraining inter-factor correlations to zero; $\chi^2(13) = 88.42$, $p < .001$, RMSEA = 0.18, SRMR = 0.25, CFI = 0.86) models had poorer model fit. Moreover, the model in which *nervous* and *jittery* loaded onto trait anxiety, instead of trait fear, had a poorer fit to the data, $\chi^2(13) = 58.44$, $p < .001$, RMSEA = 0.14, SRMR = 0.08, CFI = 0.91, indicating that *nervous* and *jittery* reflect the latent factor of fear rather than anxiety. These findings demonstrate that the two-factor model was the best-fitting model with fear and anxiety as distinct, but correlated, constructs.

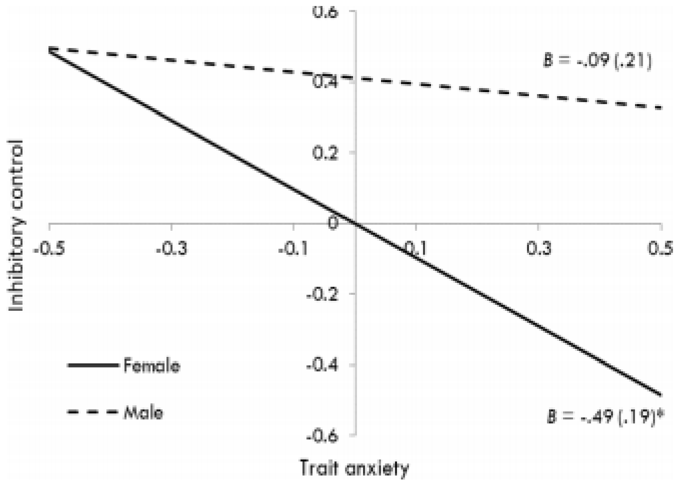
Next, we assessed the full measurement model by including inhibitory control and the two-factor model of fear and anxiety. Model fit was excellent, $\chi^2(31) = 37.59$, $p = .193$, RMSEA = 0.04, SRMR = 0.03, CFI = 0.99. In the model, neither trait fear ($\varphi = 0.17$, $SE = 0.10$, $p = .100$) nor trait anxiety ($\varphi = -0.04$, $SE = 0.10$, $p = .651$) was significantly correlated with inhibitory control. However, when inhibitory control was regressed on trait fear and trait anxiety in the structural model—which partials out the shared variance between fear and anxiety—fear ($\gamma = 0.41$, $SE = 0.16$, $p = .011$) and anxiety ($\gamma = -0.34$, $SE = 0.15$, $p = .027$) positively and negatively predicted inhibitory control, respectively (Fig. 1). We further examined whether these unique relations would hold if the covariates of gender (0 = *female*, 1 = *male*), age (in years), and socioeconomic status (indexed by household income; 1 = *less than S$2500*, 9 = *more than S$20,000*) were controlled for. The model fit was good, $\chi^2(58) = 72.05$, $p = .102$, RMSEA = 0.04, SRMR = 0.06, CFI = 0.98, and the unique relations of fear ($\gamma = 0.42$, $SE = 0.16$, $p = .008$) and anxiety ($\gamma = -0.33$, $SE = 0.15$, $p = .028$) with inhibitory control remained significant; none of the covariates significantly predicted inhibitory control (γs = −0.05 to 0.16, ps > 0.16). Crucially, our findings demonstrate that fear and anxiety are uniquely and differentially related to inhibitory control, over and above the influence of covariates.

Fig. 1. Structural equation model of fear and anxiety predicting inhibitory control with standardized estimates. The two parcels from the STAI-T were denoted STAI-T 1 and 2. All estimates were significant at the 0.05 level, except for the error variance of STAI-T 2 (p = .051). Numbers at the ends of the shorter, single-headed arrows are error terms. Numbers on the longer, single-headed arrows signify path coefficients. Numbers on the curved, double-headed arrows indicate correlation coefficients.



Last, we explored the moderating influence of gender by evaluating the significance of the fear x gender and anxiety x gender interaction terms when they were independently added to the model with covariates. The fear x gender term was not significant (γ = 0.16, SE = 0.11, p = .14), thereby indicating that the fear-specific relation with inhibitory control was not moderated by gender. In contrast, the anxiety x gender term was significant (γ = 0.18, SE = 0.09, p = .04). A further simple slopes analysis revealed that anxiety uniquely and negatively predicted inhibitory control for females (B = −0.49, SE = 0.19, p = .012) but not for males (B = −0.09, SE = 0.21, p = .679; see Fig. 2), indicating that the anxiety-specific association with inhibitory control was evident only for females, but not for males.

Fig. 2. Simple slopes analysis of gender moderating the unique relation between trait anxiety and inhibitory control with unstandardized estimates (and standard errors in parentheses). Latent variable values range from −1 *SD* to +1 *SD* for trait anxiety and inhibitory control.
* $p < .05$.



5. Discussion

We found dissimilar unique relations of dispositional fear and anxiety with inhibitory control, even when common covariates were controlled for. Specifically, the finding that higher trait fear is uniquely concomitant with better inhibitory control dovetails with past work showing that experimentally induced fear states augment inhibitory control (Finucane, 2011). Given the malleability of inhibitory control (Diamond, 2013), experiences of rational fear may demand more top-down and immediate adaptation to cope with the threat, which could in turn translate to more proficient inhibitory control. Conversely, we found that higher trait anxiety is uniquely associated with lower inhibitory control; this aligns with previous findings that highlight the negative relation between trait anxiety and inhibitory control (e.g., Bishop, 2009; Derakshan et al., 2009; Fox, 1993) as well as the attentional control theory (Eysenck et al., 2007), which posits that anxiety impairs top-down cognitive control. Our findings are also in line with theories (e.g., revised reinforcement sensitive theory) that postulate motivational differences between fear and anxiety—owing to the more explicit threat specificity in fear than in anxiety—which in turn affect attentional mechanisms (Gray & McNaughton, 2000; Harmon-Jones et al., 2013; Öhman, 2008). Specifically, fear sharpens attentional focus and promotes inhibitory control, while anxiety broadens attentional scope and diminishes inhibitory control. Our study is the first to show the differential unique associations of trait fear and trait anxiety with inhibitory control.

Our results are also consistent with the idea that affective traits comprise valence and motivational components. Accordingly, state level relations derived from mood-induction procedures, which more strongly activate the motivational aspects of affect, may be attenuated at the trait level when affective experiences are averaged over extended periods (Harmon-Jones & Harmon-Jones, 2010). Moreover, our results highlight the fact that previous null findings of trait anxiety on inhibitory control using neutral stimuli (e.g., Derakshan et al., 2009; Eysenck & Byrne, 1992) could be attributed, in part, to the fact that components unrelated to inhibitory control (e.g., negative valence) may mask potential relations between trait anxiety and inhibitory control.

Further, our finding of the significant anxiety x gender interaction effect illuminates a key boundary condition. As demonstrated by simple slopes analysis, the negative effect of anxiety on inhibitory control (e.g., Eysenck et al., 2007) was evident only for females and not for males. Given previous findings that females experience higher levels of trait anxiety (as also shown in our study, $p = .051$), anxiety symptoms, and anxiety disorders than males (e.g., Bernstein et al., 2006), our findings imply that females are more susceptible to the deleterious effects of anxiety on inhibitory control. In contrast, the absence of an interaction effect of trait fear and gender indicates that the effect of trait fear on inhibitory control does not differ between males and females. Taken together, our moderation results suggest that higher levels of trait anxiety are concomitant with lower inhibitory control in females but not in males.

Next, our use of bin scores to index inhibitory control is worthy of further discussion. We propose three reasons based on findings from our supplementary analyses. First, when we considered other performance metrices—such as accuracy, reaction time (RT), and linear integrated speed-accuracy score (LISAS; Vandierendonck, 2017)—to reflect the underlying latent factor of inhibition control, we found that relative to these metrices (e.g., difference scores in the RT, accuracy, and LISAS), bin scores showed the highest factor loadings onto the inhibitory control latent factor (see Table A1 of Appendix A). These results indicate that bin scores best represent the inhibitory control construct, and therefore are most suitable for purposes of the latent variable approach, which is one of the central features of our study. Second, following Vandierendonck (2017), we inspected consistency in the directionality of the relations between inhibitory control and speed and accuracy scores (see Table A2 of Appendix A). We found that the directions of the effects of trait fear and trait anxiety on RT difference scores (reverse-coded) and accuracy scores in the incongruent condition are akin to our results based on bin scores. Specifically, trait fear and trait anxiety are positively and negatively related to inhibitory control, respectively. Although not all of the effects based on RT and accuracy scores reached statistical significance, it is notable that the use of integrated measures (e.g., bin scores) may still be advantageous as long as RT and accuracy scores point in the same direction (Vandierendonck, 2017)[2]. Therefore, our use of bin scores is permissible due to the similarity in the direction of the effects based on RT and accuracy scores.

Table 1. Descriptive statistics of predictors, covariates, and criterion variables.

	M	*SD*	Min	Max	Skewness	Kurtosis	Reliability
Predictors							
Fear[a]							.82
Afraid	2.33	0.89	1.00	5.00	0.47	0.25	–
Scared	2.46	0.89	1.00	5.00	0.26	−0.21	–
Nervous	2.67	0.85	1.00	5.00	0.28	0.19	–
Jittery	2.45	0.91	1.00	5.00	0.19	−0.53	–
Anxiety[a]							.79
Distressed	2.79	0.79	1.00	5.00	0.12	0.21	–
STAI-T Parcel 1	2.31	0.50	1.40	3.70	0.16	−0.33	–
STAI-T Parcel 2	2.33	0.51	1.20	3.60	0.11	−0.52	–
Covariates							
Gender (% female)	66.3	–	–	–	–	–	–
Age (years)	21.59	1.83	19.00	27.00	0.63	−0.10	–
Income[b]	3.94	2.29	1.00	9.00	0.92	−0.12	–
Criterion							
Inhibition control[c]							
Arrow flanker[d]	−6.27	1.66	−14.78	−3.69	−1.87	5.76	.93
Color flanker	−6.31	0.96	−9.24	−3.52	−0.17	0.73	.71
Eriksen flanker[d]	−6.19	0.87	−9.66	−4.20	−0.94	1.53	.70

[a] For trait fear and trait anxiety, reliability estimates were computed based on Cronbach's alpha.
[b] Household income, as an index of socioeconomic status, was reported on a 9-point scale (1 = less than S$2500, 9 = more than S$20,000).
[c] For inhibitory control tasks, reliability estimates were calculated using Spearman-Brown adjusted split-half correlations.
[d] As a result of administrative and technical errors, data were missing for the arrow (n = 2) and Eriksen flanker (n = 1) tasks.

Our study has several limitations. Foremost, given that dispositional fear and anxiety were assessed using global self-reports, they may be susceptible to reporting biases (e.g., recent affective experiences; Schwarz & Strack, 1999). However, it should be noted that global self-reports of trait negativity are strongly correlated with state negativity and other-reports (e.g., clinicians and family members), which demonstrates that global self-report responses are not simply artefacts of response biases (Shackman et al., 2016). Nonetheless, future work should employ experiential sampling methods to verify our findings.

Table 2. Zero-order correlations between predictor, covariates, and criterion variables.

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. Afraid	–											
2. Scared	**.72**	–										
3. Nervous	**.57**	**.50**	–									
4. Jittery	**.52**	**.43**	**.48**	–								
5. Distressed	**.32**	**.27**	**.39**	**.31**	–							
6. STAI-T Parcel 1	**.51**	**.45**	**.48**	**.46**	**.47**	–						
7. STAI-T Parcel 2	**.52**	**.45**	**.47**	**.50**	**.56**	**.85**	–					
8. Arrow flanker	−0.05	.03	**.16**	.08	−0.05	−0.04	−0.03	–				
9. Color flanker	**.15**	.10	.05	.05	−0.01	−0.04	−0.00	**.30**	–			
10. Eriksen flanker	.10	.08	.07	−0.00	.03	−0.01	−0.07	**.25**	**.45**	–		
11. Gender[a]	−0.09	−0.10	**−0.20**	.01	−0.09	**−0.19**	−0.12	**.16**	.07	.05	–	
12. Age	−0.09	−0.10	−0.12	−0.01	−0.09	**−0.16**	**−0.17**	.14†	−0.02	.02	**.58**	–
13. Income	−0.03	.03	−0.06	.07	−0.02	−0.02	.02	−0.04	.03	.06	−0.14†	**−0.31**

Note. All values denote Pearson product-moment correlation coefficients. Significant results are marked in boldface, $p < .05$, $^{\dagger}p < .10$.
[a] Gender was coded as 0 = *female*, 1 = *male*.

Second, while inhibitory control was indexed by multiple measures, trait fear and trait anxiety were primarily measured by the PANAS and the STAI-T, respectively. Moreover, it is possibile that the two latent fear and anxiety factors were differentiated not by their constructs, but by construct-irrelevant aspects (e.g., questionnaire characteristics). For instance, the PANAS relies on single-word adjectives (e.g., *afraid*), while the STAI-T uses short phrases (e.g., "I worry too much over things that do not really matter") and contains reverse-coded items (e.g., "I am happy"). Nevertheless, it should be noted that our findings from confirmatory factor analysis show that the item *distressed* from the PANAS loaded onto the anxiety factor—rather than the fear factor, which contain other PANAS items—even though other indicators of the anxiety factor are parcels from a different scale (i.e., STAI-T). Further, another alternative model in which *distressed* loaded onto the fear factor, instead of the anxiety factor, had a poorer fit relative to our model, $\chi^2(13) = 50.62$, $p < .001$, RMSEA = 0.13, SRMR = 0.06, CFI = 0.93. These results show that the item *distressed* from the PANAS loads onto the latent anxiety factor—rather than the latent fear factor—and that the separability of trait fear and anxiety was not driven solely by differences in questionnaire characteristics between the PANAS and STAI-T. Nevertheless, future research should employ multiple scales to capture each individual latent construct of trait fear and trait anxiety, which would more convincingly circumvent differences in questionnaire characteristics.

Third, the correlational design of our study limits causal inferences. It is plausible that greater inhibitory control permits the effective engagement of emotion regulation strategies (e.g., reappraisal) in ameliorating experiences of fear and anxiety. Hence, future studies should consider the potential role of emotion regulation in the relation between fear/anxiety and inhibitory control using longitudinal designs.

In conclusion, our findings accentuate the importance of distinguishing fear and anxiety and their distinct contributions to inhibitory control. Our findings also highlight the need to consider affective traits as multidimensional constructs to achieve a more refined understanding of negative affectivity and cognitive processes.

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Appendix A

Table A1. Standardized factor loadings of inhibitory control tasks.

	RT-d	RT-c	RT-i	ACC-d[a]	ACC-c	ACC-i	LISAS-d	LISAS-c	LISAS-i	Bin
Arrow flanker	.46 (0.16)	.85 (0.05)	.73 (0.07)	–	.12 (0.10)	.40 (0.13)	.24 (0.14)	.71 (0.09)	.51 (0.10)	.40 (0.08)
Color flanker	.44 (0.18)	.74 (0.06)	.71 (0.07)	–	.83 (0.32)	.84 (0.06)	.34 (0.23)	.69 (0.07)	.63 (0.08)	.74 (0.10)
Eriksen flanker	.33 (0.12)	.71 (0.05)	.63 (0.07)	–	.47 (0.19)	.80 (0.08)	.43 (0.27)	.69 (0.06)	.65 (0.09)	.61 (0.09)

Note. Factor loadings in boldface are significant at $p < .05$. RT = reaction time, ACC = accuracy. LISAS = linear integrated speed-accuracy score. -c signifies congruent condition, -i denotes incongruent condition, and -d reflects difference scores between incongruent and congruent conditions.

[a] Standardized factor loadings were not obtained for ACC-d due to model nonidentification.

Table A2. Standardized estimates for trait fear and trait anxiety across different latency and accuracy scores of inhibitory control tasks.

	Trait fear	Trait anxiety
RT-d	.26 (0.24)	−0.30 (0.25)
RT-c	−0.04 (0.16)	−0.07 (0.15)
RT-i	.04 (0.16)	−0.13 (0.16)
ACC-d[a]	–	–
ACC-c[a]	–	–
ACC-i	.24 (0.14)†	**−0.29 (0.14)**

Note. Standardized estimates (with standard errors in parentheses). Significant results are marked in boldface, $p < .05$, † $p < .10$. RT = reaction time (reverse-coded by multiplying by −1); ACC = accuracy. -c signifies congruent condition; -i denotes incongruent condition; and -d reflects difference scores between incongruent and congruent conditions.

a Standardized path estimates of trait fear and trait anxiety are unavailable for ACC-d and ACC-c due to model nonidentification.

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